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Beechcraft

PROTOTYPE DEVELOPMENT
MODEL 385 AIR REFUELING STORE

June 12, 1963

Prepared Under Navy, Bureau of Naval Weapons

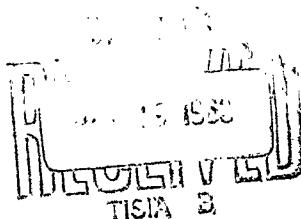
Contract NAW 60-0060-c

Interim Report No. 36

Engineering Report 4788

1 May 1963 Through 31 May 1963

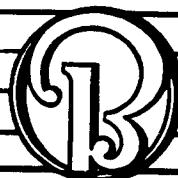
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BEECH AIRCRAFT CORPORATION

WICHITA 1, KANSAS, U. S. A.





Beech Aircraft Corporation
Wichita, Kansas

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Engineering Report

Engineering Report 4788
June 12, 1963

ABSTRACT

Ground operational testing of the prototype Model 385 Air Refueling Store has continued during the month of May, 1963. All problem areas have now been satisfactorily resolved; the store is presently enroute to Patuxent for Navy flight test evaluation, which is scheduled to resume on June 17. Major improvements have been incorporated in the store cable system, drogue and refueling hose, response capability, and fuel system. Design work is in process toward manufacture of two additional flight test articles.



Engineering Report

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June 12, 1963

STATEMENT OF WORK (1 May Through 31 May 1963)

Development of the Beech Model 385 Air Refueling Store has continued during this reporting period. Efforts have been concentrated upon modification and ground operational testing of the prototype store. Various problem areas encountered during recent flight test attempts at NATC have now been satisfactorily resolved. Improvements have been incorporated in the store cable system, variable diameter drogue, refueling hose, response system, fuel system and electrical system. These various changes have been thoroughly checked out by extensive ground operational testing.

The store was shipped on June 6 for return to Patuxent. It is anticipated that Navy flight tests can be resumed during the week of June 17. Design work has been started on two additional flight test stores. These stores will incorporate improved features resulting from the recent value engineering task, together with changes indicated by continued evaluation testing of the prototype article. A total of 8 engineers are presently working on the program.

Following is a brief description of the various modifications which have been incorporated in the prototype store:

Cable System - Dual cable tensioners have been added to the boom lift and hose retract cable systems. Each tensioner consists of a cable pulley connected to a spring and guided in a track for fore and aft movement. Tensioner travel is sufficient to prevent slack in the primary cables for their entire travel, with dual reliability for more than half of their travel. In addition to the tensioners, guards have been added to the cable drums. To provide space for the tensioner, it was necessary to eliminate the floating pulley assembly, which previously interconnected the hose retract and response cables. This has resulted in a slight reduction (3 feet) in trailed length of the refueling hose; it is believed that this improves the formating position for aircraft such as the F-4. Elimination of the interconnect between the retract and response cables prevents a possible source of progressive failure.

Variable Diameter Drogue - Revisions to the drogue have consisted of shortening the leaves, reduction in drogue cone angle, addition of drag producers, strengthening of the leaves and stiffening of the drogue springs. The first two changes, which reduce the maximum target diameter to approximately 28 inches, will improve the engagement characteristics and prevent interference with "cobra" type receiver probes. It was determined that the drogue leaves could be easily broken by side wise



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STATEMENT OF WORK (Continued)

deflection due to the drogue going out of round when impacted on the tip of the leaf. A stop ring has been provided to prevent increase in cone angle on the leaf first contacted; clearance has been reduced at the leaf hinge to keep the drogue round, and side wise bending strength of the leaves has been increased by addition of steel doublers at the leaf hinges. Addition of drag producers and stiffening of the drogue springs has resulted in over 50% increase in low speed drogue drag; this permits a corresponding increase in response power. Application of dry film lubricant to the working parts of the drogue has prevented a major increase in stowage force due to the stiffer springs.

Refueling Hose - As described in last months report, it was determined that the refueling hose became very stiff when subjected to full fuel pressure, resulting in a drastic reduction in response capability. This problem was traced to the removal of inherent lubrication from the outer braid by chemical processing for marking the hose. Flexibility has been restored by application of dry film lubricant. There is some indication that engagement and initial response characteristics are affected by the length of the stiff tubing at the trailing end of the hose. (This tube was shortened between the experimental and prototype stores due to a change in the boom shape. The boom has been reworked to accommodate the longer tube. Buckling strength of this tube has also been increased by use of heavier wall tubing.

Response System - An increase of approximately 50% in basic response power has been provided by increasing the charging pressure of the drag strut. This change was possible due to the increase in low speed drogue drag, permitting the hose to extend to full trail against the higher response setting. In addition, the drag strut spring rate has been modified by change in strut initial volume, resulting in less drop off of response power as the hose is taken in. These changes, together with lubrication of the hose and revised sequencing of fuel pressure, have resulted in a major improvement in response characteristics.

Fuel System - Fuel system changes have consisted of relocation of the fuel shutoff valve, rearrangement of fuel system control, modification of the F-4 fuel disconnect nipple and revision of the hose depressurization system. The fuel shutoff valve has been moved from the inlet to the outlet side of the store boost pump. This change allows the refueling hose to remain depressurized during the extend and retract cycles. In addition, the fuel system controls have been revised such that the store pump will not start until an appreciable flow (from gravity and tanker pressure) has been established. This feature prevents full fuel pressure from being applied until the probe and



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STATEMENT OF WORK (Continued)

coupling are fully engaged; also startup surge is considerably softened. During fuel transfer attempts at the recent Patuxent "tests", there were reports of fuel leakage in the vicinity of the store pod. The store disconnect fitting, which engages into a socket in the F-4, is provided with vertical "float" to accommodate installation tolerances and deflections. It is possible that leakage could occur at this point due to excessive travel available. The fitting has been revised to prevent this possibility. Another possible source of the reported fuel "puffs" could be the vent for depressurization of the hose. This overboard vent has been eliminated and the depressurization line routed back to the tanker vent system.

Electrical System - The store electrical system has been revised to correspond with the above changes in the fuel system. During recent ground operational tests, the store started to retract while in a fuel transfer cycle and when coupled to the simulated receiver. This condition was caused by inadvertent loss of 28 volt DC power to the store, with 115 volt AC power remaining on. An interlock relay has been added to interrupt the AC power in the event of loss of DC power.



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PROGRAM FOR NEXT MONTH

Development of the Beech Model 385 Air Refueling Store will continue during the month of June, 1963. The primary activity during this period will be flight test evaluation of the prototype store by NATC at Patuxent River, Maryland. Increasing activity is expected in design and release of data for manufacture of additional test articles.